Complexity

FIG. 1

Complexity

FIG. 2

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W. H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. D. Goldstein, "Sea echo in propagation of short radio waves," In D. E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 3

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W. H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. D. Goldstein, "Sea echo in propagation of short radio waves," In D. E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

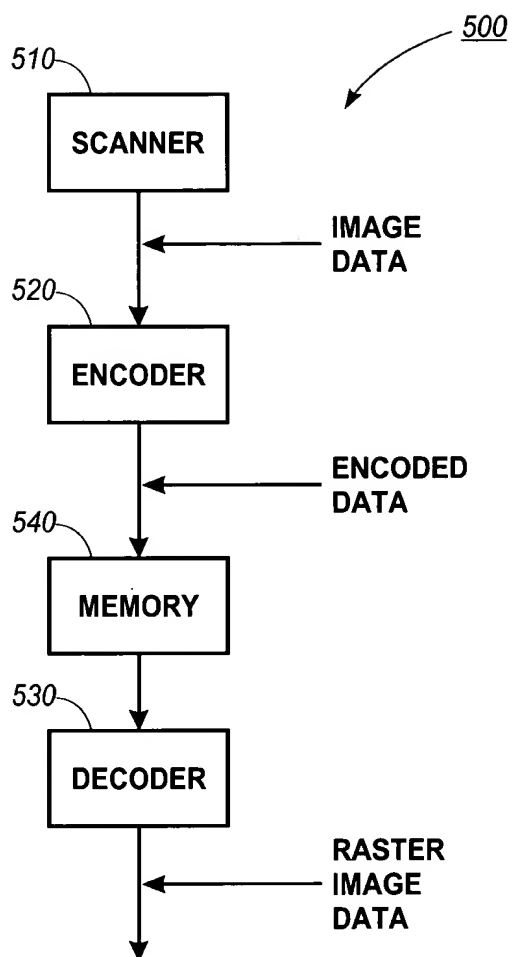5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 4

500

510 ┐

SCANNER

← IMAGE DATA

520 ┐

ENCODER

← ENCODED DATA

540 ┐

MEMORY

530 ┐

DECODER

← RASTER IMAGE DATA

FIG. 5

START —S600

SCAN IMAGE TO GENERATE
HIGH RESOLUTION
GRAYSCALE IMAGE DATA —S610

BINARIZE GRAYSCALE IMAGE DATA —S620

IDENTIFY BOUNDARY PIXELS —S630

SAVEVALUES OF GRAYSCALE
BOUNDARY PIXELS —S640

STORE HIGH RESOLUTION
BINARY IMAGE DATA AND
VALUES OF GRAYSCALE
BOUNDARY PIXELS —S650

RENDER IMAGE USING
HIGH RESOLUTION BINARY
IMAGE DATA AND VALUES OF
GRAYSCALE BOUNDARY PIXELS —S660

STOP —S670
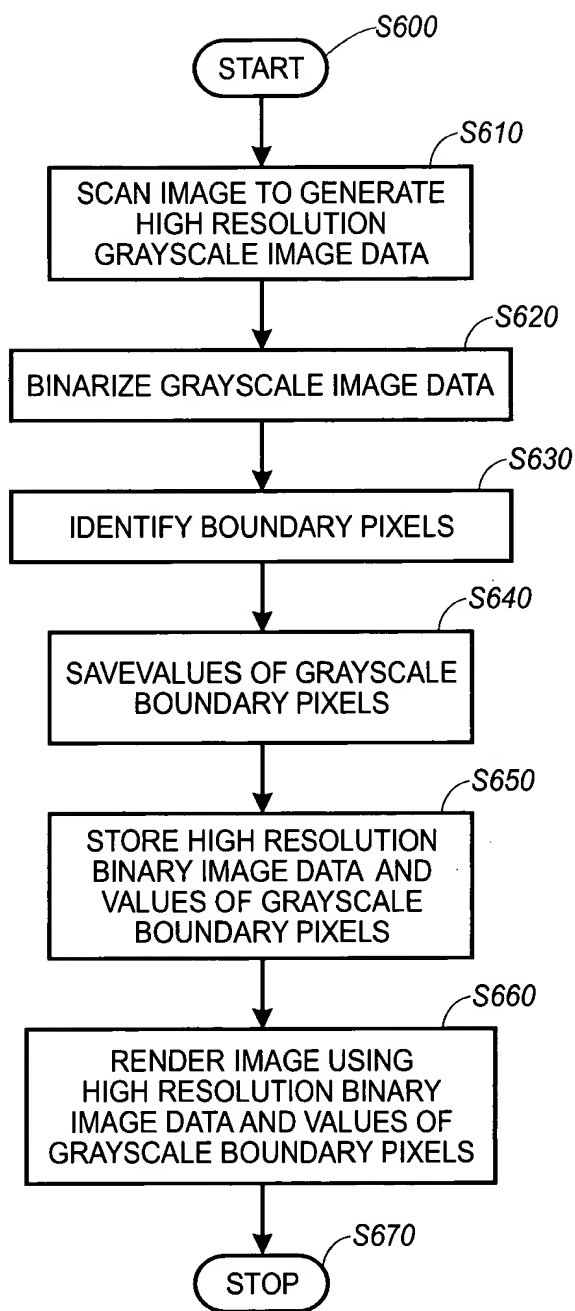
FIG. 6

FIG. 7   Complexity

FIG. 8   Complexity

FIG. 9   Complexity

FIG. 10   Complexity

FIG. 11   Complexity

FIG. 12   Complexity

FIG. 13

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.
2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.
3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.
4. H. Goldstein, "Sea echo in propagation of short radio waves," in D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.
5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 14

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.
2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.
3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.
4. H. Goldstein, "Sea echo in propagation of short radio waves," in D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.
5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 15

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.
2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.
3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.
4. H. Goldstein, "Sea echo in propagation of short radio waves," in D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.
5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

START ~S1600

SCAN IMAGE TO GENERATE HIGH
RESOLUTION GRAYSCALE IMAGE DATA ~S1610

BINARIZE HIGH RESOLUTION IMAGE DATA ~S1620

IDENTIFY BOUNDARY PIXELS ~S1630

SEPARATE INTERIOR AND
EXTERIOR BOUNDARY PIXELS ~S1640

SEPARATELY ANALYZE INTERIOR AND
EXTERIOR BOUNDARY PIXELS' CONNECTIVITY ~S1650

CALCULATE GRAYSCALE VALUES
FOR THE BOUNDARY PIXELS ~S1660

STORE HIGH RESOLUTION BINARY
IMAGE DATA AND DERIVED VALUES
OF GRAYSCALE BOUNDARY PIXELS ~S1670

RENDER IMAGE USING HIGH RESOLUTION
BINARY IMAGE DATA AND DERIVED VALUES
OF GRAYSCALE BOUNDARY PIXELS ~S1680

STOP ~S1690

FIG. 16

Histo of pixel values of interior (ON) boundary pixels

Number of pixels

Pixel value

FIG. 17

FIG. 18

Median pixel values of interior (ON) boundary pixels

Number of oppositely colored (OFF) 4 cc pixels

Median grayscale value

FIG. 19

FIG. 20

Complexity

FIG. 21

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. H. Goldstein, "Sea echo in propagation of short radio waves," In D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

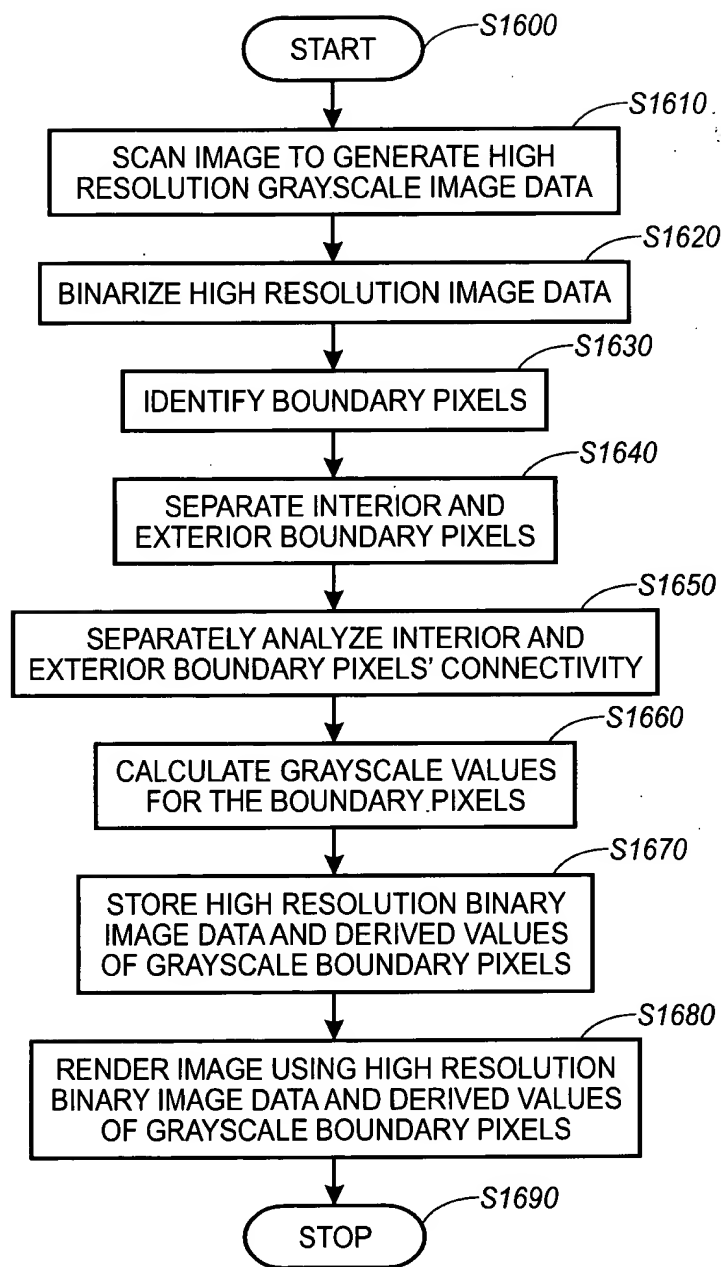5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 22

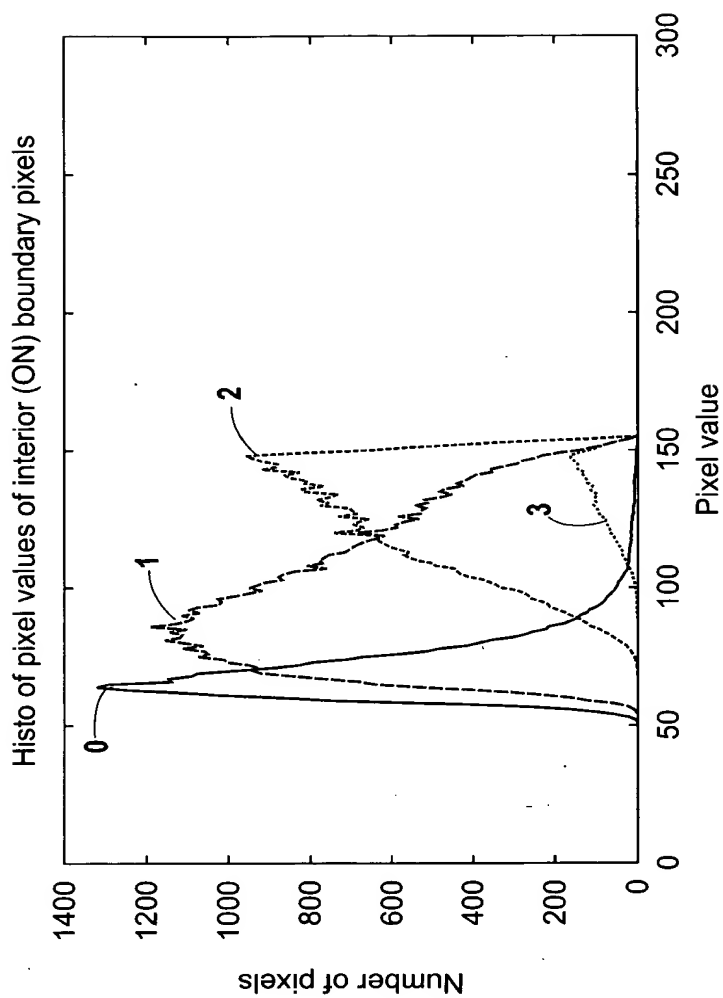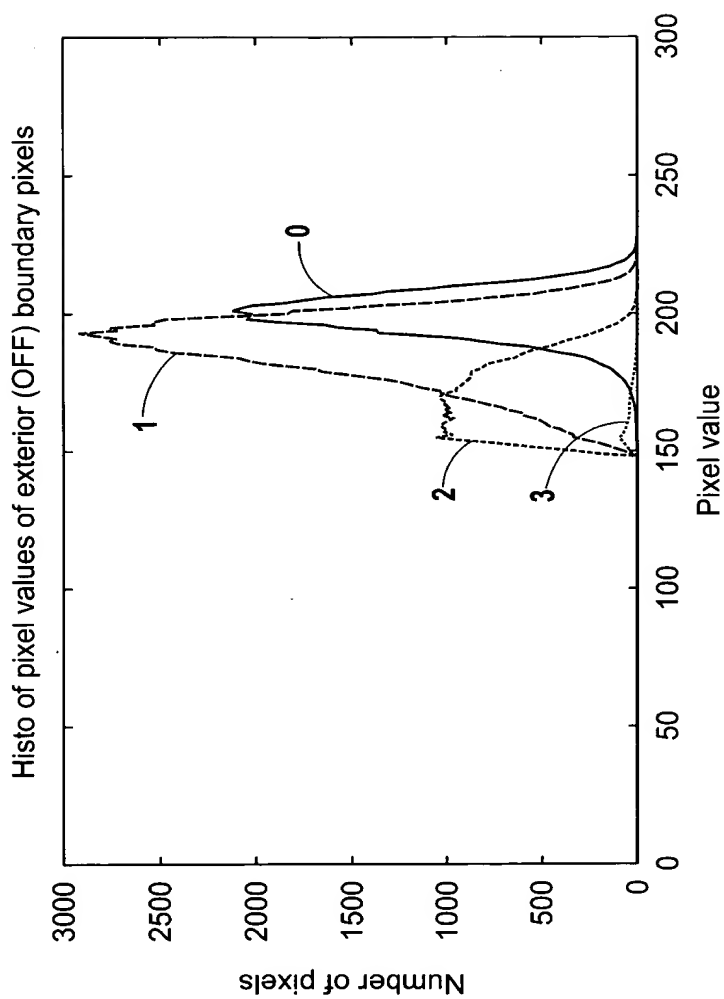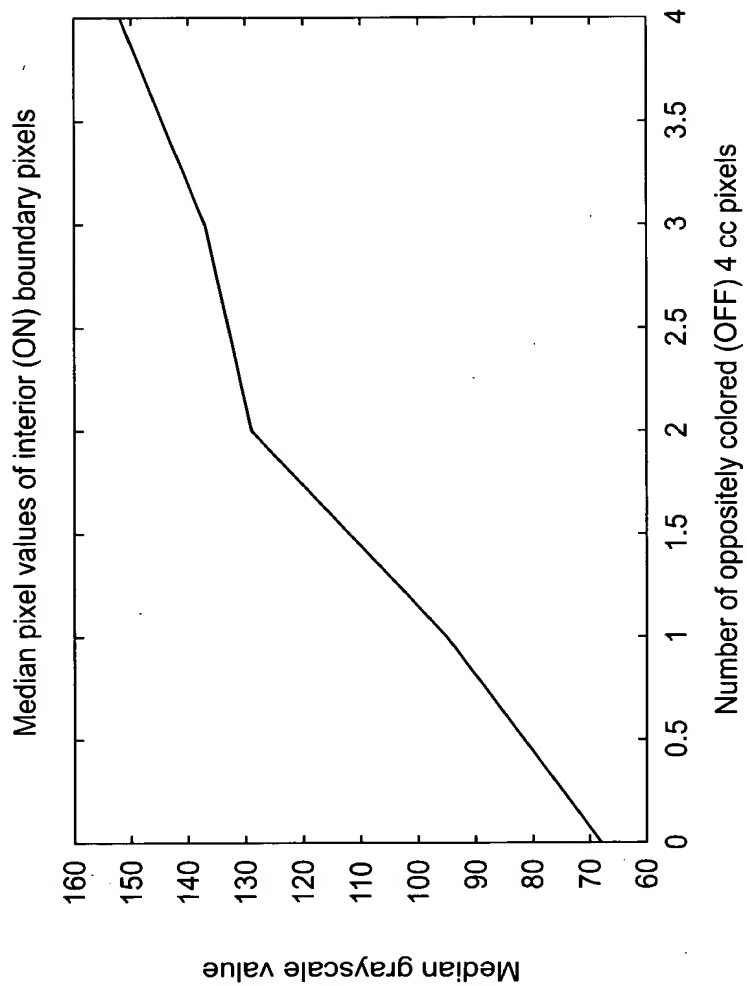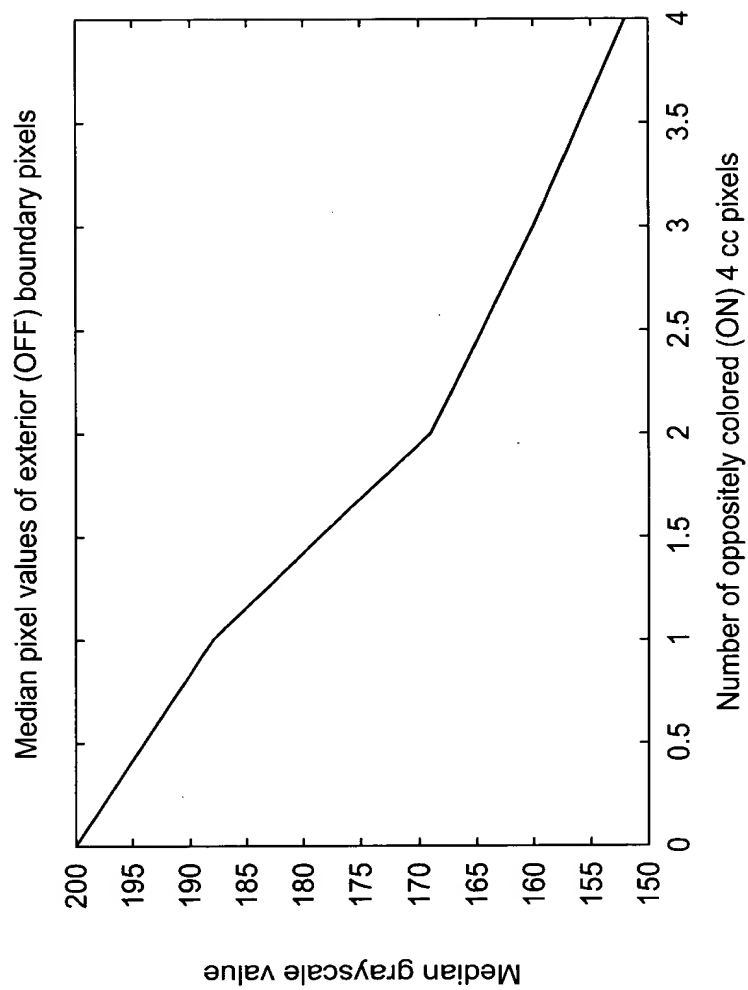**Complexity**

FIG. 23

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. H. Goldstein, "Sea echo in propagation of short radio waves," In D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 24

START — S2500

SCAN IMAGE TO GENERATE HIGH
RESOLUTION BINARY IMAGE DATA — S2510

IDENTIFY BOUNDARY PIXELS — S2520

ESTIMATE MEDIAN BOUNDARY PIXEL VALUES — S2530

SEPARATE INTERIOR AND
EXTERIOR BOUNDARY PIXELS — S2540

SEPARATELY DETERMINE APPROXIMATE
DEPENDENCY BASED ON
CONNECTIVITY FOR INTERIOR AND
EXTERIOR BOUNDARY PIXELS' — S2550

STORE HIGH RESOLUTION BINARY
IMAGE DATA AND VALUES
OF GRAYSCALE BOUNDARY PIXELS — S2560

RENDER IMAGE USING HIGH RESOLUTION
BINARY IMAGE DATA AND ASSIGNED VALUES
OF GRAYSCALE BOUNDARY PIXELS — S2570

STOP — S2580

FIG. 25

Complexity

FIG. 26

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. H. Goldstein, "Scattering in propagation of short radio waves," in D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

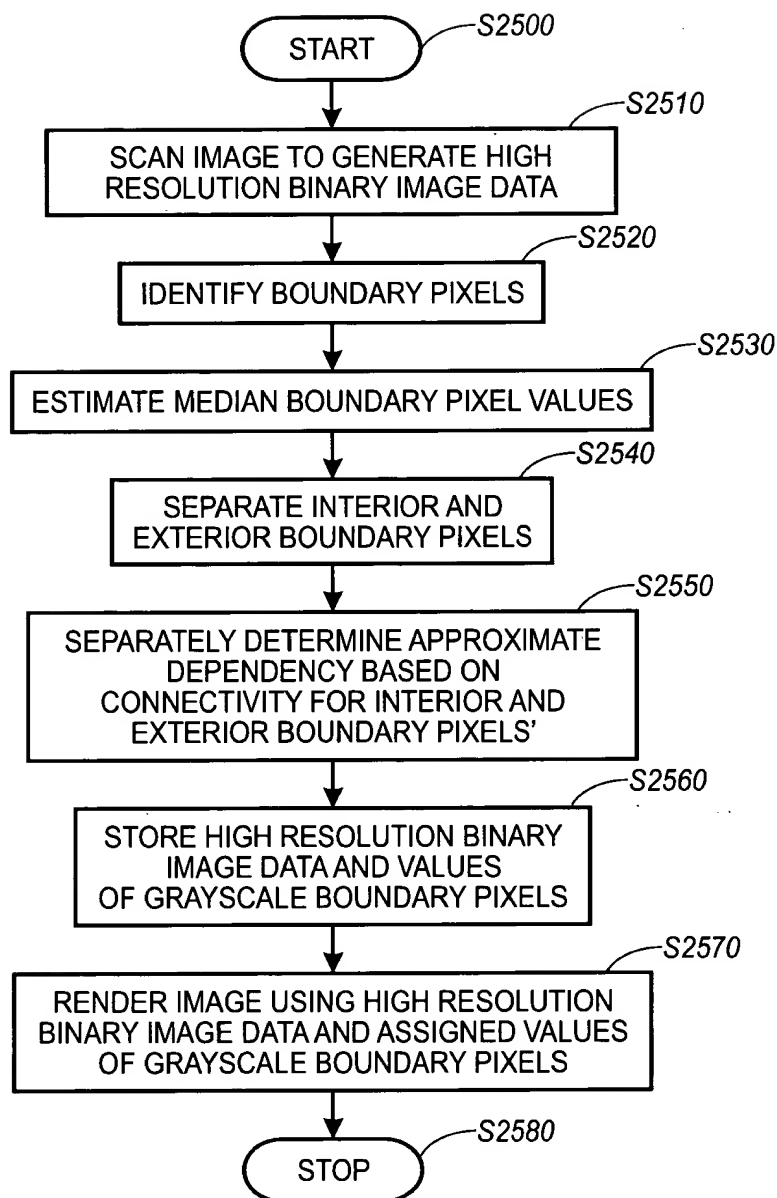5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 27

START ⟶ S2800

SCAN IMAGE TO GENERATE HIGH
RESOLUTION BINARY IMAGE DATA — S2810

IDENTIFY BOUNDARY PIXELS — S2820

SEPARATE INTERIOR AND
EXTERIOR BOUNDARY PIXELS — S2830

SET FIRST AND SECOND GLOBAL GRAYSCALE VALUES — S2840

ASSIGN A FIRST GLOBAL GRAYSCALE VALUE
TO INTERIOR BOUNDARY PIXELS AND
A SECOND GLOBAL GRAYSCALE VALUE TO
EXTERIOR BOUNDARY PIXELS — S2850

STORE HIGH RESOLUTION BINARY
IMAGE DATA AND GRAYSCALE
VALUES OF THE BOUNDARY PIXELS — S2860

RENDER IMAGE USING HIGH RESOLUTION
BINARY IMAGE DATA AND ASSIGNED GRAYSCALE
VALUES OF THE BOUNDARY PIXELS — S2870

STOP — S2880

FIG. 28

FIG. 29

FIG. 30

```
                    ┌─────────────┐   ╭─ S3100
                    │    START    │
                    └─────────────┘
                           │
                           ▼                      ╭─ S3110
      ┌──────────────────────────────────────┐
      │   SCAN IMAGE TO GENERATE VERY HIGH    │
      │     RESOLUTION BINARY IMAGE DATA      │
      └──────────────────────────────────────┘
                           │
                           ▼                  ╭─ S3120
          ┌────────────────────────────┐
          │   FILTER VERY HIGH RESOLUTION │
          │      BINARY IMAGE DATA        │
          └────────────────────────────┘
                           │
                           ▼                ╭─ S3130
         ┌────────────────────────────────┐
         │   DOWN SAMPLE FILTERED DATA     │
         │   TO PRODUCE HIGH RESOLUTION    │
         │      GRAYSCALE IMAGE DATA       │
         └────────────────────────────────┘
                           │
                           ▼              ╭─ S3140
            ┌──────────────────────────┐
            │   THRESHOLD TO BINARIZE   │
            └──────────────────────────┘
                           │
                           ▼              ╭─ S3150
           ┌───────────────────────────┐
           │   IDENTIFY BOUNDARY PIXELS  │
           └───────────────────────────┘
                           │
                           ▼                  ╭─ S3160
         ┌────────────────────────────────┐
         │       STORE HIGH RESOLUTION     │
         │  BINARY IMAGE DATA AND GRAYSCALE │
         │       BOUNDARY PIXEL DATA        │
         └────────────────────────────────┘
                           │
                           ▼                    ╭─ S3170
      ┌──────────────────────────────────────┐
      │  RENDER IMAGE USING HIGH RESOLUTION   │
      │    GRAYSCALE IMAGE DATA AND           │
      │   GRAYSCALE BOUNDARY PIXEL DATA       │
      └──────────────────────────────────────┘
                           │
                           ▼          ╭─ S3180
                    ┌─────────────┐
                    │    STOP      │
                    └─────────────┘
```
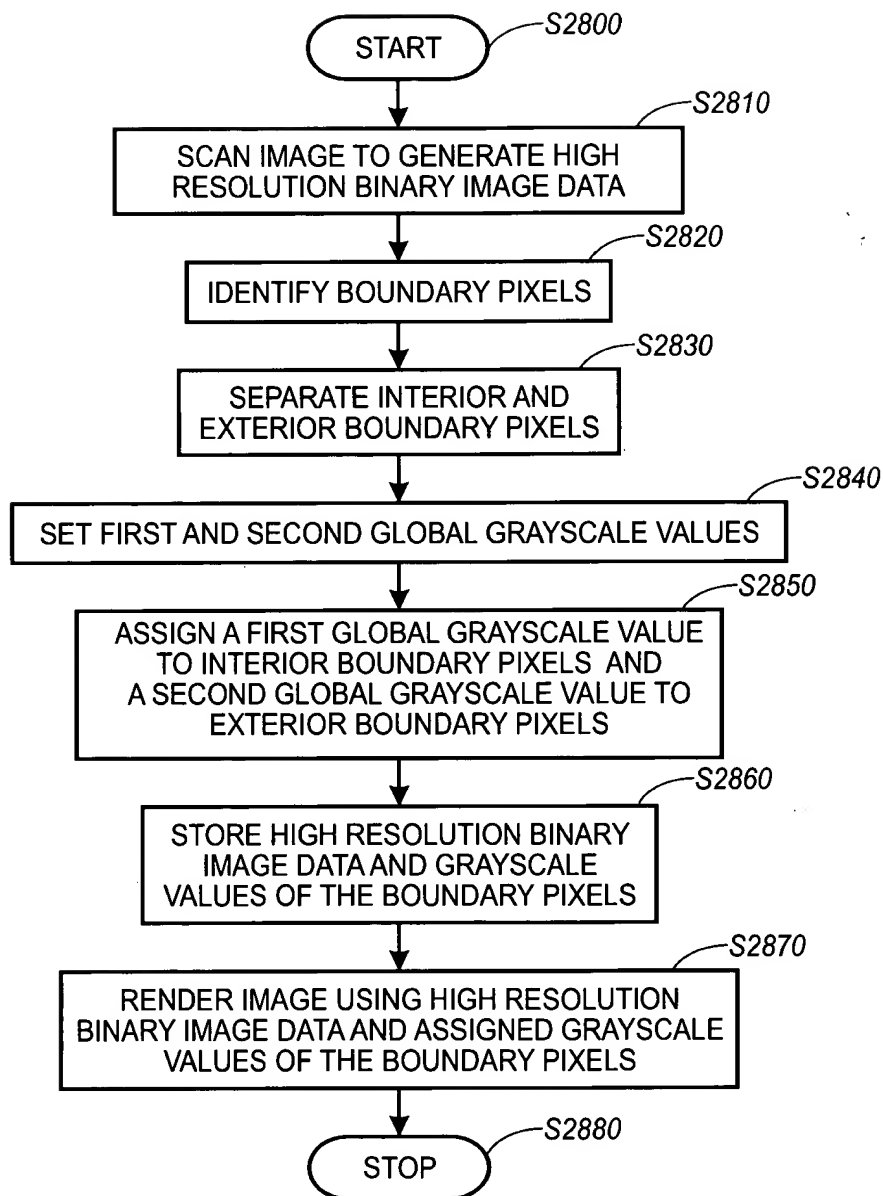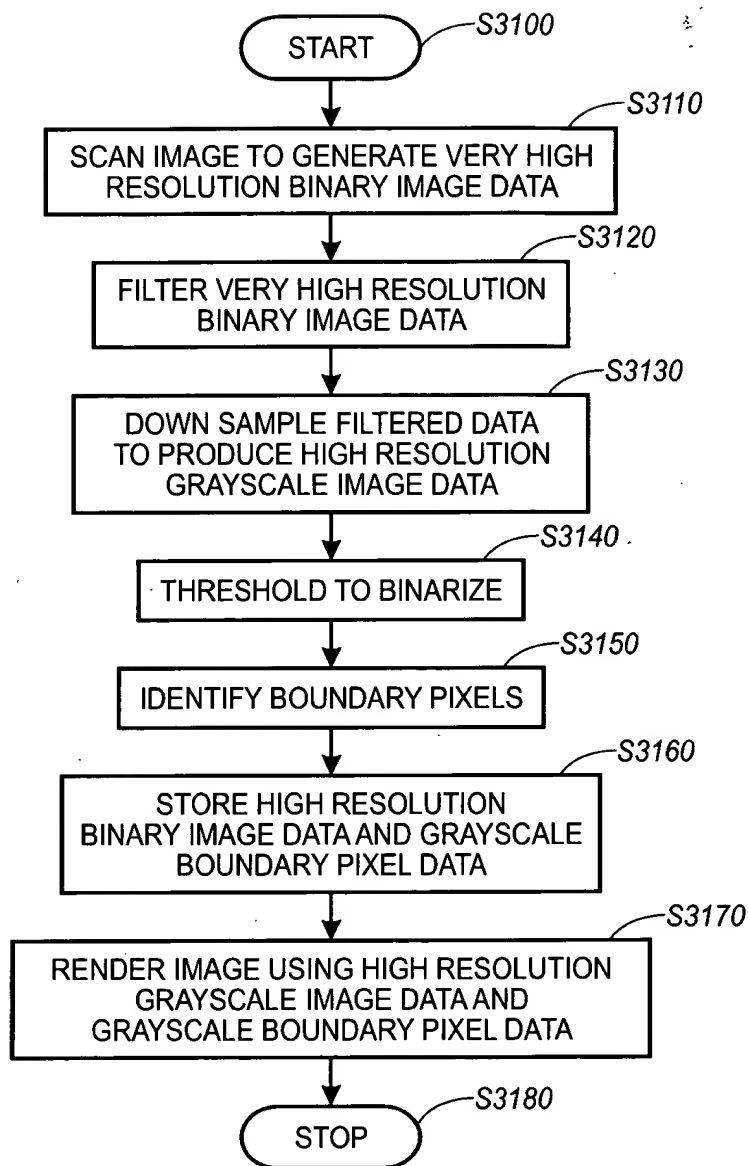
FIG. 31

Complexity

FIG. 32

1. G. Nicolis and I. Prigogine, "Exploring Complexity: An Introduction," W.H. Freeman, 1989.

2. M. Casdagli, "Nonlinear prediction of chaotic time series," Physica D 35, pp. 335-356, 1989.

3. S. Haykin and S. Puthusserypady, "Chaotic dynamics of sea clutter," CHAOS, Vol. 7, No. 4, pp. 777-802, December 1997.

4. H. Goldstein, "Sea echo in propagation of short radio waves," In D.E. Kerr, editor, MIT Radiation Laboratory Series, Vol. 13, Section 6.6, McGraw-Hill, 1951.

5. M. Skolnik, editor, "Radar Handbook," Second edition, McGraw-Hill, 1990.

FIG. 33